Science News-Letter

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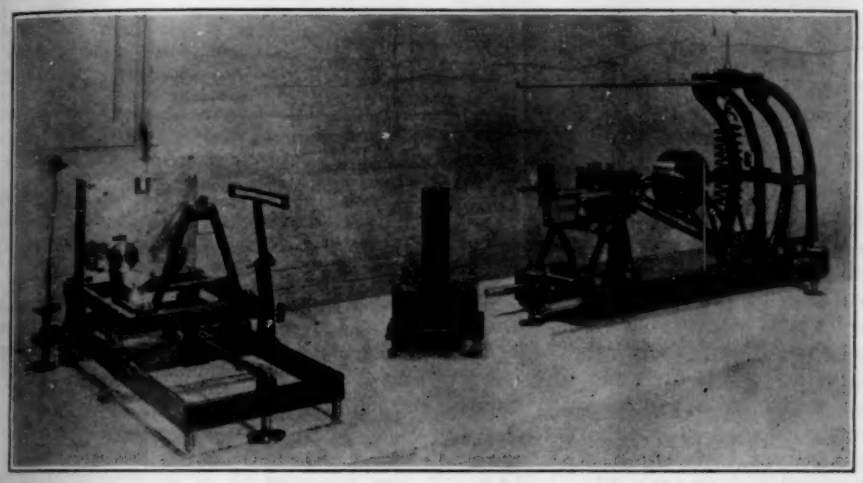
SEISMOLOGY

Earthquakes Send Their Own Telegrams



GALITZIN SEISMOGRAPH at Georgetown University, Washington. The round weight, in the instrument to the right, remains stationary during an earthquake, while the other parts move up and down around it. Attached to the weight are small coils of wire connected to the galvanometer in the center. The coils are between the poles of the magnet and their motion relative to the magnetic field produces a minute electric current which is detected by the galvanometer and recorded photographically in the apparatus to the left.

Last Monday, October 24, there was an earthquake at 10:59½ A. M., Eastern Standard Time. At 4 o'clock on Monday afternoon Science Service announced that the U. S. Coast and Geodetic Survey, which cooperates with it in locating earthquakes, had found that the quake centered at 61 degrees north latitude and 140 degrees west longitude. This is on the Alaska-Canadian boundary, about 75 miles north of Yakutat Bay. But not until the next day did any reports of it reach the United States from Alaska, while it will probably be some time still before full accounts are received from the affected area.

Long before telegraphic dispatches from the region of a quake reach distant points, scientists are able to tell that it occurred and even to locate definitely the center of the disturbance. The earthquake has sent its own dispatch to those who have the instruments, and the experience, to read the message. The seismograph, which is the machine that detects these tremors, even when occurring in the opposite parts of the earth, is based on a very simple principle. Lay a piece of paper on a table, and place a coin on it. Then suddenly pull the paper away. If you do it quickly enough, the coin will not move, but will drop to the table immediately under the place that it occupied on the paper.

How the Seismograph Works

The seismograph works in precisely the same way. The reason that the coin did not move with the paper, was that it possessed what the physicist calls inertia, or resistance to motion when it is standing still. The seismograph has a heavy weight, often hundreds of pounds, corresponding to the coin. It is suspended like a pendulum, so that it can move freely. But when the earthquake occurs, it does not move. The vibrations are transmitted through the earth, and the earth vibrates slightly even at points far away from the region of greatest activity. Just as the coin kept still when the paper was moved, the pendulum remains stationary and the earth moves under it.

Fastened to the pendulum is a small needle which is in contact with a sheet of smoked paper on a drum that is set firmly on the ground, so that when the vibration comes the drum with the smoked paper moves under the needle and a record is obtained. Actually there is usually a system of levers which magnifies the relative motion of the drum and the pendulum, and sometimes the needle and smoked paper is replaced by a beam of light reflected from a

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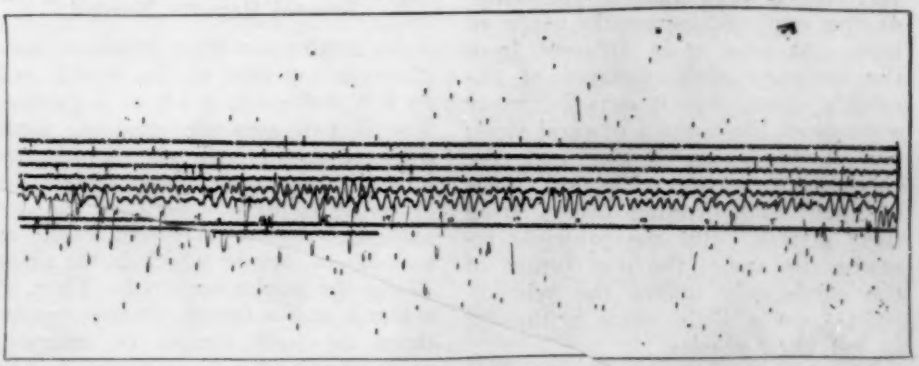

AN EARTHQUAKE RECORD OR "SEISMOGRAM" made with the seismograph shown above. This is the autograph of the Santa Barbara earthquake.

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Earthquakes Send Own Telegrams

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tiny mirror on the pendulum and a photographic film, but the principle is the same.

But even when the record is obtained, to the average citizen, it would simply indicate that an earthquake has happened some place. The important question is "where is it?" Far from the usual notion, an earthquake is not a promiscuous shaking, but follows definite laws. The typical quake consists of several parts, first the preliminary phase, then the secondary and finally the third or long phase. At the "epicenter" or the center of the disturbance these three phases occur so closely after each other that it would be almost impossible to distinguish them, but the waves do not travel with the same velocity. The preliminary phase of the recent quake in Santa Barbara was felt in Washington about seven minutes after it occurred, while the secondary phase arrived about five and a half minutes later. The greater the distance, the greater the difference between the two phases, and from this difference as measured by the seismograph, seismologists may find the distance of the quake.

Their job is complicated by the fact that a large mass at the center of the earth is apparently made of iron. At least it is different from the ordinary rock-substance of the earth's crust, for it acts in many ways more like a mass of rigid steel; and it does queer tricks with the earthquake waves, reflecting some of them and bending others from their course. But the principle remains the same; the iron center of the earth only makes the seismologists use a little more arithmetic to get their results.

The Direction of a Quake

The estimating of the direction of an earthquake center is a more difficult matter. It depends on the fact that the pendulum of a seismograph is "pointed" in a certain direction, and will behave differently if an earthquake wave hits it parallel or transversely, just as a straw floating on a pond bobs in one way if the ripples catch it lengthwise, and in another if they take it crosswise. Most well-equipped seismological stations have several instruments, with their pendulums "pointed" in various directions, so that their results can be compared and checked against each other. At best, it is difficult to tell the exact direction of an earthquake center from the observations of a single station, and sometimes even good observers will have the distance quite right, and the violence properly estimated, but be "off" on the direction by 180 degrees of a circle, stating that the quake was in the southeast instead of the northwest.

This, then, locates the epicenter on a circle a certain distance from the station where the seismograph is located, and approximately in a certain direction. As there are certain regions of the earth where earthquakes are most likely to occur, when the seismologist sees that this circle crosses one of these earthquake zones, it is probable that it is the source of the tremor.

Several Reports Needed

An earthquake may, however, take place in any part of the world, and so this method is a bit of a gamble. But if two separate stations, some distance apart, both get records, we have circles around each. Unless the epicenter is directly between the two stations, these circles intersect at two places, one of which is the place where the quake occurred. Then, if a third, and a fourth, station report, three or four circles to intersect each other and help to determine the exact location.

For years there have been a number of seismograph observatories in

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ENGINEERING

Gas to Prevent Smoke

Gas made from bituminous coal was declared the ideal household fuel of the future in a report by Prof. S. W. Parr of the University of Illinois to the first national fuels meeting held recently in St. Louis under the auspices of the American Society of Mechanical Engineers.

Charging that the average home and apartment heating plant is guilty of producing most of the smoke nuisance of cities today, Prof. Parr predicted that raw coal would eventually become obsolete as a fuel and that instead the soft coal would be processed to produce a solid smokeless fuel more desirable than anthracite, gas of high quality and tar from which drugs, dyes and many other chemicals can be obtained. Smokeless combustion, high efficiency, cleanliness and convenience give gas a status unapproached by any other fuel, Prof. Parr declared.

Why smoke practically always results from the burning of bituminous coal in ordinary furnaces was explained. When coal is heated it gives off gases, among them marsh gas and ethylene. Before marsh gas will burn it must be heated to a bright cherry red heat, about 1200 to 1300 degrees Fahrenheit, and ethylene requires a temperature half as great. If such gaseous products of coal strike a cool surface that lowers their temperatures below their ignition points, or if there is not enough oxygen to allow them to completely combust, they become smoke producers instead of giving off heat.

"In the large steam-generating plant the production of great volumes of smoke is an unnecessary extravagance, inefficient, wasteful, unsanitary and avoidable," Prof. Parr said. "Proper combustion can be controlled in a very effective manner

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ZOOLOGY

Whales Champion Divers

Whales make the stoutest submarines look exceedingly tame when it comes to diving. According to R. W. Gray, a British naturalist, they reach depths of 700 to 800 fathoms, or from 4200 to 4800 feet, when they are attacked. They do not make a gradual, sloping descent, either, but stand on their noses and go right straight down. This behavior is known to whalers as "sounding."

In the old days, when whales were

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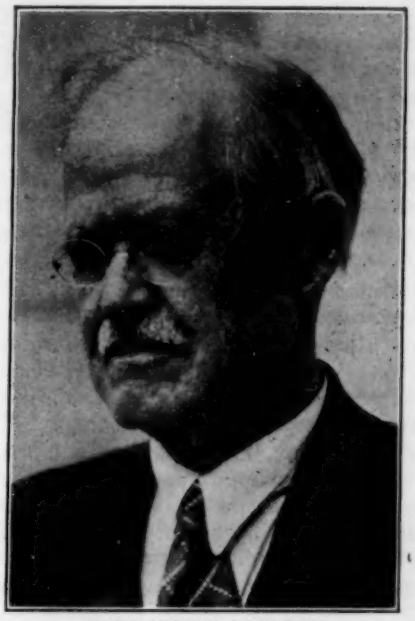
BOTANY



JOHN MERLE COULTER

Dean of American Botanists

In the spring of 1872, the personnel of the first scientific expedition into the then almost unknown Yellowstone National Park was encamped at Ogden, Utah, waiting for its chief to come on from the East. The youngest geologist in the party, a youth just out of college, spent his spare time collecting the plants of the region and trying, without much success, to classify them out of a manual of botany designed for the eastern United States.

When Dr. Hayden appeared and found the incipient herbarium which young John Coulter had got together, he created a new position of botanist to the expedition and put him into it. Thus did a great geologist rob his own profession to give American botany one of the foremost men in its whole history.

Twenty-four years later, President Harper was going about the country seeking whom he might devour for his new university. He found Dr. Coulter filling the posts of president and professor of botany at Indiana University, and offered him the headship of the department at Chicago. For a solid generation thereafter, until his retirement in 1925, Dr. Coulter wrote large pages in the history of American botany. He manned his department with his own graduate students; the record of their teaching and research activities justifies the use of that slightly overworked term, impressive. He made Chicago the source of an army of competent botanists; there are a few leading botany departments in this

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ENTOMOLOGY

Poisons May Check Beetles

While admitting that the Japanese beetle was about as abundant as ever in its plant devastations in the East this past summer, government entomologists believe orchardists and gardeners at last have reached the point where they can spray the foe into consistent rout.

The fact has vast economic importance, because the destroyer feeds freely on no less than 200 plants, including those bearing the peach, apple, pear and grape, besides numerous vegetables and shade trees.

Ever since the insect's discovery in New Jersey many years ago, and its alarmingly rapid spread throughout the East, the government has been unable to devise a really first-rate means of control. In New Jersey and portions of Pennsylvania, Delaware, New York and Connecticut, quarantines have been enforced, with varying success. Present indications point strongly to quarantine extension throughout Maryland and the District of Columbia which would place retrictions on interstate movements of most kinds of farm and garden products.

The early discovery that the beetles and grubs form a portion of the diet of several species of birds, at first was thought to be scientifically important. But the diet was found not to be regular enough to seriously check the insect's multiplication.

Use of insecticides proved somewhat more encouraging. Yet the difficulty was that the Japanese

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PHYSICS

Light Speeds Factory Work

Far less waste in human energy and health in thousands of factories throughout the country may result from a series of novel lighting experiments just completed by C. E. Ferree and Gertrude Rand of Bryn Mawr College. A paper emphasizing the high lights of the experiments was read before the joint session of the annual conventions of the National Committee for the Prevention of Blindness and the Illuminating Engineering Society in Chicago.

A number of factory workers were tested for the quickness with which they could see details in terms of black and white. It was found that whether the object is white against a black background, or vice versa, there is a rapid increase of speed as

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Poisons May Check Beetles

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beetle is to the insect world what the gray wolf of the western plains was to the animal world—a killer extraordinary with exceptional cunning. Sensitive to such foreign materials on its tasty foods as the common arsenical poisons, it refused often to taste them, with the result that instead of curling up and dying it was wont to sneak away to other plants free from contamination for a safe feast.

However, several new sprays and lures have been devised this year. Geraniol, an oil found in geranium and certain other plants, has proved especially effective. When applied to trees in the open the "drink" often attracts beetles from as far away as half a mile. Traps used in this connection likewise have been useful. They consist of simply made contrivances accessible to the beetles from the outside into which they find themselves entrapped after maneuvers around a geraniol bait.

The beetle's grub, a particular nuisance in grass lands and golf putting greens, has been controlled by thorough saturation of the soil with carbon disulfide emulsion and applications of arsenate of lead.

Another tried beetle destroyer is a mixture of lead arsenate with a small amount of lead oleate soap.

Next summer, by establishing for the first time in history a contact man to induce civic bodies and others to systematically control the insect by intelligent spraying, the U. S. Bureau of Entomology will set a long hoped-for precedent.

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Light Speeds Factory Work

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the amount of light is increased, up to 15 or 20 foot-candles. One foot candle means the light a man gets on his work when it is one foot from a standard candle.

The significance of the tests is that the application of three to four times the usual amount of light multiplies the speed of the work virtually by a corresponding amount. Furthermore, the prevailing opinion on factory lighting is that four to five foot-candles are adequate for general purposes. In other words, while there is no way of measuring a man's eye strain, the tests prove conclusively that eye strain may be lessened greatly by increasing the light to the point where the eye will work at its optimum speed.

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Dean of American Botanists

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country that do not have a Chicago graduate on their staffs. He founded and edited the Botanical Gazette, one of the foremost scientific journals in the world. He wrote and collaborated in writing a very solid array of books. He took an active part in organizing a number of botanical and other scientific societies.

Finally, at an age when most men are content to rest on their honors, he interested his friend William Boyce Thompson in the construction and endowment of a great institute for plant research at Yonkers, N. Y., where a new technology, which may properly be called plant engineering, is being developed. It is as head of the Boyce Thompson Institute for Plant Research that Dr. Coulter spends the days of his very active "retirement."

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Foresters estimate that more timber has been burned up in forest fires than has been cut down.

The mummy of Tutankhamen was adorned with 143 pieces of jewelry of religious significance.

Gas to Prevent Smoke

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by such devices as slow and evenly distributed additions of coal or by special setting of the boiler, hence the modern mechanical stoker and the elevated or elongated boiler settings to provide both space and time for the combustion of gases before cold surfaces are encountered.

"The case, however, with the average household or apartment heating unit is entirely different. Here the high heats do not prevail. The mechanical stokers as well as the spacious combustion spaces are absent. Moreover, the man of the house or the janitor has other duties to perform, whereupon he fills the combustion chamber to the limit and sets the dampers for a prolonged period of automatic control, during the major part of which period the so-called heater is simply a device for stewing off tars and vapors of inconceivable variety as to composition, odor and filth for the effective work of polluting the atmosphere. In the very nature of the case, such conditions must exist and continue to prevail in any household appliance where raw coal is fed into the furnace. No matter by what name the furnace or the coal is known, by any other name they would smoke just the same, and the worst part of the picture is not fully presented until mention is made of the fact that as a result of exhaustive studies made in many congested centers, it is demonstrated that the major part of the smoke nuisance has its origin in the domestic chimney and in the larger units of flat and apartment buildings where combustion conditions in the furnace are substantially as described above.

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Whales Champion Divers

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hunted with hand harpoons or with gun harpoons of a type that did not kill them quickly, the huge sea beasts frequently died at the limit of their dive, and getting them back to the surface was a long and arduous task. Sometimes in shallow water they crashed into the bottom and thus killed themselves.

Mr. Gray is of the opinion that the thickness of the whale's blubber, or protective layer of fat, may have something to do with its "sounding" ability. He notes that the Greenland whale, which has very thick blubber, can reach much greater depths than its relative the narwhal.

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CHEMISTRY

New Chemical to Prevent Auto Freezing

What to place in auto radiators to keep them from freezing is the problem that auto owners must now consider. Freezing nights will soon be here.

Shall it be alcohol, glycerine, glycol, chlorides or some other suggested chemical? Careful studies of the advantages and disadvantages of the anti-freeze solutions suggested have been made by experts.

The two common alcohols, denatured ethyl alcohol, and poisonous wood alcohol or methanol, are the most easily available and cheapest anti-freeze agents.

Denatured ethyl alcohol is used to the extent of some 40 million gallons a year as an anti-freeze. Its principal disadvantage is that it evaporates and is lost, causing the radiator to need constant refilling. Its cheapness makes up for this waste.

There is one important disadvantage common to both alcohols. When cars are finished with Duco or some other cellulose lacquer, alcohol must be used with great care or not at all as the spilling of even a small amount of alcohol radiator solution will dissolve and ruin the finish.

Denatured alcohol is usually preferable to wood alcohol in spite of the fact that 10 per cent. less wood alcohol is required for protection against freezing at any given temperature. Wood alcohol has poisonous fumes and it sometimes contains free acids which will damage the radiator.

Glycerine is a favorite anti-freeze especially with those who have lacquered cars. Glycerine is more expensive than alcohol but it does not evaporate very readily and one filling of the radiator should last a whole season if the radiator is free from leaks. Either the colorless chemically pure glycerine or the yellow distilled commercial grade can be used with safety but the crude product is dangerous because it usually contains salts that corrode the radiator.

When placing either alcohol or glycerine in the radiator do not fill it above two inches from the top of the overflow pipe since the solution will expand when the radiator warms up.

Mixtures of alcohol and glycerine are often used as a compromise between the cost of glycerine and the volatility of alcohol.

A relatively new anti-freeze compound that is beginning to be available in sufficient quantity is the chemical, ethylene glycol, made synthetically from petroleum. It has advantages of both alcohol and glycerine and costs about as much as glycerine. It does not affect lacquer finishes, flows easily, does not evaporate and lowers the freezing point of the solution more effectively than alcohol. It is considered by some chemists to be an ideal anti-freeze compound.

Calcium and magnesium chlorides have been widely sold under trade names as anti-freeze compounds. Their serious disadvantage is that they corrode and cause serious damage to the engine jacket and radiator, particularly aluminum and solder. A soluble chromate added to them tends to prevent this corrosive effect except upon aluminum and this chemical is contained in some of the salt mixtures on sale.

Sugar, honey, and glucose are condemned on the grounds that they do not lower the freezing point sufficiently and are too viscous. Lubricating oil is also ineffective as a radiator solution because of its low heat capacity and high viscosity, while kerosene is dangerous due to inflammability, danger of overheating, and its solvent action on rubber.

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LIST GIVES RIGHT PROPORTIONS

Following table, based on U. S. Bureau of Standards tests, gives proper amounts of various safe anti-freeze chemicals that should be added to radiator water.

Percentage, by volume, in water

Freezing Temperature, Fahrenheit	Denatured Alcohol	Wood Alcohol	Distilled Glycerine	Ethylene Glycol
20°	19%	12%	22%	16%
10°	30%	20%	32%	25%
0°	38%	29%	40%	32%
—10°	45%	34%	47%	39%
—20°	52%	40%	54%	44%

Example: If denatured alcohol is used, minimum temperature is 20 degrees and the radiator holds 3½ gallons, the radiator solution must contain 19% alcohol, that is, about one-fifth of it by volume. Proper solution can be made by adding one-fifth of 3½ gallons, a little more than 5½ pints, of alcohol to 11 quarts of water.

PHYSIOLOGY

Yeast Is Vitamin Source

Yeast is the best source of the concentrated vitamin B extract used by Dr. Barnett Sure of the University of Arkansas in his experiments on the prevention and cure of beriberi in young rats, as described in a recent issue of the SCIENCE NEWS-LETTER (October 1). Dr. Sure states that his most marked results have been obtained since he ceased using wheat germs and adopted yeast as his raw material.

A point of much importance in the development of dietetics for the young is stressed by the Arkansas physiologist. "While babies need cod liver oil, orange juice or tomato juice," he says, "they also need something which has heretofore been unappreciated by pediatricians, and that is large amounts of vitamin B."

In the previous item Dr. Sure was referred to as dean of the agricultural college at the University of Arkansas, whereas he occupies the position of professor or agricultural chemistry.

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HOME ECONOMICS

Fingerprints of Muffins

Suppose you had to record the life histories of hundreds of muffins baked in a long series of experiments to find out how the very best muffins are made—how would you contrive to keep the identity of those good muffins, and not-so-good muffins, and extra-good muffins, and really impossible muffins straightened out?

Miss Mary Little, a teacher of Tuscaloosa who has been studying muffins in order to win her Master of Arts degree, solved the problem by fingerprinting a cross section of each muffin in her laboratory. The prints were taken with mimeograph ink, very much as fingerprints of criminals are made at police headquarters. No two muffins have the same fingerprints, Miss Little has found.

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Earthquakes Send Own Telegrams

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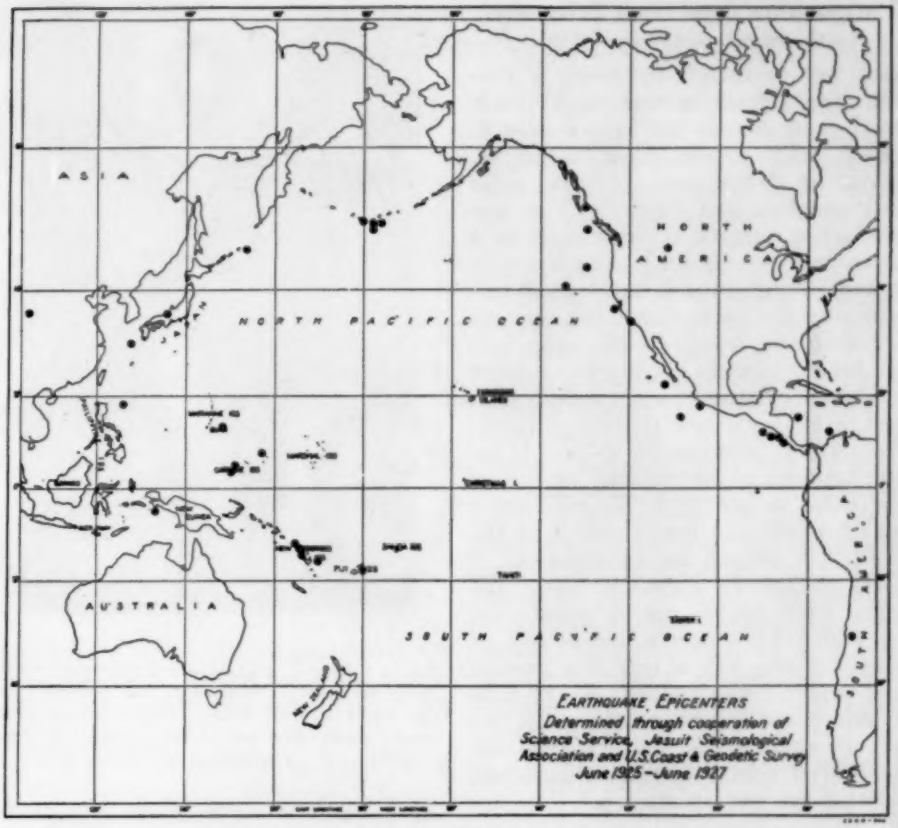
various parts of the United States, but only comparatively recently have their efforts been coordinated so that their records would be most useful. A few years ago all the earthquake investigations of the U. S. Government were placed in the Coast and Geodetic Survey, in charge of Commander N. H. Heck. This division began to gather earthquake reports from various universities, as well as its own observatories, and publish the results.

But many months were sometimes required to determine a quake, and still are required for a final determination. In order that the location of an earthquake might be determined within a few hours after it happened, and with considerable accuracy, Science Service, in June, 1925, started to cooperate with the Survey. By this arrangement the seismograph observatories of the Survey, as well as at various universities, and a few in foreign countries, telegraph or cable the data to Science Service in Washington immediately after the record of a quake is obtained. For this purpose a special code is used, so that the message may look something like this:

ENBAIPUXEN BAENOTFIOT
AMENFIDEFI ENDEUXKUEN
FIOTENBABA IPDEEOTBAIP
VYVYVYBAAM KUBAENOTBA.

When decoded this gives practically all the data that the seismogram —the record taken off the instrument —does. This data is given to the experts at the Survey, and a determination of the epicenter of the quake is usually made within a few hours after it occurred. The location of the quake is then made public by Science Service through the daily press.

A few months after this scheme of cooperation was put into effect the Jesuit Seismological Association was organized. For many years, the Jesuit colleges of the United States have operated many of the principal seismograph observatories, one of the chief of which is that at Georgetown University, Washington, in charge of Rev. F. A. Tondorf, S. J. This association was intended to coordinate their work, just as the Coast and Geodetic Survey had coordinated the Government's work. The scheme of cooperation then became a triple one, between Science Service, the Jesuit Seismological Association and the Survey. The data obtained from the earthquake stations is also telegraphed on to the headquarters of the Jesuit Association in St. Louis, under the direction of Rev. James B. Macelwane, S. J. Here an independent determination of the quake is made and telegraphed back to Washington, as a further check on accuracy.



MAP SHOWING LOCATION OF EARTHQUAKES located during first two years of Science Service's cooperation with the Coast and Geodetic Survey and the Jesuit Seismological Association

A striking illustration of the value of this cooperation was obtained last spring when a very severe earthquake occurred on May 22 in the Kan-Su province of China. The following day Science Service announced its location, but not until July did reports reach civilization from the devastated region, which confirmed the first announcement.

The Cause of an Earthquake

The ultimate cause of an earthquake is the transfer of material from one part of the earth to another. By the process of erosion, whole mountains may be moved, and vast canyons, like that of the Colorado River in Arizona, may be cut. The most important agency of erosion is water. Rain falls on a mountain and each drop washes away a small part, which is carried down to the valley below. Infinitesimal as the effect of a single drop is, when the process is carried over a period of thousands of years the effect is enormous. This changes the loading of the earth's surface. A vast amount of material may have been carried into a valley, thus increasing the weight there, while the neighboring mountain may have been reduced in size. The result is a slipping of the heavier part to readjust itself, and it slips along a definite line which geologists call a "fault".

When a fault is once established, other slips may occur along it in the future. To determine the places where quakes are most likely, maps have been made showing the principal faults which are known to exist. California has been most completely studied in this way and a fault map, issued by the Seismological Society of America, in cooperation with various government agencies, shows hundreds of them. But probably other parts of the country would also show a large number if studied as completely.

A Quake in a Layer Cake

Faults need not be open fissures in the rock; in fact, they seldom are. Most faults are detected simply by the fact that the layers or strata of

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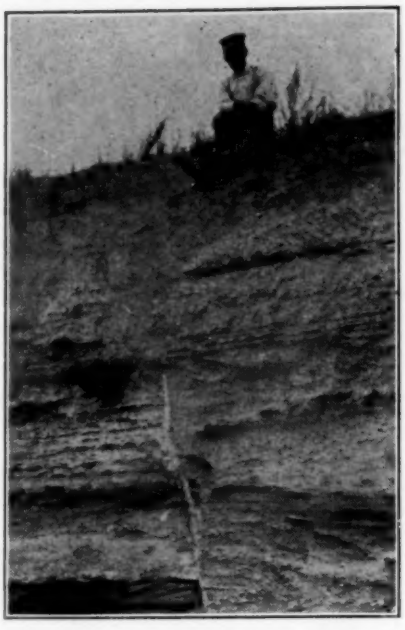
rock fail to match up along a certain line. Such a line is a "fault line," and marks the place where, under great stress from above or below or from one side the solid rock cracked and slipped. You can produce a fault on a small scale in a layer cake, by slipping a knife under it and lifting until it breaks. When you take the knife away, the chances are that the layers in the cake will no longer match up evenly. After a while, perhaps, the heaved-up part will settle back into position a little; the fault is readjusting itself. If an ant happens to be walking on top of the cake at the time, he will get a bit of a jolt: the readjustment of the fault has caused an earthquake.

As in the little world, so in the big. This round, cosmic layer-cake on which we humans live is full of places where the layers are pushed and twisted out of place. Every time a new push causes another slip, we get an earthquake. Every time the dislocated parts readjust themselves a little, we get another jar.

These movements of dislocation and readjustment may take place either up, down, or sideways, and sometimes they are of quite considerable extent. Dr. Bailey Willis, a prominent seismologist who happened to be in Santa Barbara at the time of the earthquake, noted that the trail of an old cannon in front of the postoffice left a scar on its stone pedestal sixteen inches in length, running from north to south, thus indicating a movement of nearly a foot and a half. But the Santa Barbara earthquake was a comparatively mild one. Roads that crossed the great San Andreas fault, which caused the San Francisco disaster twenty-one years ago, were dislocated by as much as their full width, so that the right-hand edge on one side of the line met the left-hand edge on the other. Similarly, fences that ran across this fault were broken, the offset between the ends being wide enough for a good, generous-sized farm gate.

Seismologists and geologists point out that man can profit by his costly experiences with these earthquake-causing slips of rock faults. The San Franciscan's claim that "it wasn't the earthquake, but the fire, that caused most of the damage" is true. But when the fire started, the aqueducts that should have supplied water to fight it were broken in two at the fault line, just like the roads and the fences. And in too many



"FAULT" AS SHOWN ON THE SIDE OF A CLIFF. The different layers of rock were originally continuous, but the part to the right slipped down. Filling in of dirt later made the top level again. (Photo courtesy U. S. Geological Survey.)

instances, the water mains of earthquake-scourged cities have been rebuilt exactly as they were before, right across the fault lines; so that when another quake comes they will break again in exactly the same places. Similarly, railway tracks that might carry relief can be cut off. Sources of danger, like high-tension electric wires, and pipes conveying inflammable oil and natural gas, in many places stand ready for the wrecking wrench of the earthquake to add their share of death and destruction.

Measures are already being taken in California to gain a more intimate knowledge of the earthquake situation in general, so that a newer generation of engineers may be able to avoid the costly mistakes of their predecessors, and even so that scientists may predict the coming of a quake with something like accuracy. Prof. Willis tells of the initial steps in this movement.

"The Carnegie Institution of Washington is now engaged in establishing stations at Pasadena, Riverside, La Jolla, and other points in southern California," he says, "where instruments designed to record local earth tremors are being set up. All of the stations will operate in unison under the central control of the principal station at Pasadena and the records which they will yield will enable us to fix the focus of even the slightest tremors within fifty or sixty miles of the stations. As the records are continuous we shall know exactly where the earthquake strain is gathering and how it increases or diminishes from day to day or month to month.

"In the course of time a chain of stations of this character will no doubt be established from San Diego to the Oregon line. But it will have to be done through the cooperation of the communities interested and will not be accomplished until public opinion is educated to an understanding of the advantage of knowing all that we can about earthquakes and the methods of protecting ourselves against their effects."

Science News-Letter, October 29, 1927

SEISMOLOGY

Region of Past Quakes

The earthquake last Monday was not the first that has visited the region in Alaska. One of the most severe earthquakes of the earth's history occurred in Yakutat Bay in 1899. This disturbace is listed as "the earthquake of the century." Another severe earthquake shook the region on February 21, 1925.

It may take weeks for the news of the quake to be transmitted from the region to the outside world. The Alaskan coast in this locality is only sparsely settled with natives. One native village and a federal school is located at Yakutat Bay, but this is sufficiently far from the zone of greatest disturbance to arouse no fears as to its safety. Communication is limited to a coast-wise steamer that plies as far as Steward on a monthly schedule, but weather conditions at this time of year make even this meager contact unreliable.

A seismographic station of the Coast and Geodetic Survey is located at Sitka, some 300 miles away, and probably felt the shock.

The great Yakutat shock of 1899 caused vertical displacements of the earth of as much as 40 feet. While changes of the earth's surface of this extent are not likely as a result of the present shock, the configuration of the ocean bottom in that region may have been changed, causing navigation to be menaced.

Science News-Letter, October 29, 1927

A German chemical company reports that it has perfected a method of producing 100 per cent. pure tin.

Indians of the Seneca Nation in New York State passed their own law to control the corn borer two years ago.

ANTHROPOLOGY

Indian Tooth Shell Money

In the days before the white man with his gold and silver currency invaded the northern part of California, the tribes known as the Tolowa, Karok, Yurok and Hupa had a well defined monetary system established, the principal medium of exchange being the peculiarly shaped, long, white, curving dentalium or tusk shells.

Recently there came to the Museum of the American Indian Heye Foundation several strings of this shell money. In the period of American occupancy of California immediately after the gold rush and up until the late 80's, this odd currency circulated among the Indians and whites as well. Today, although new, undecorated shells of the ordinary or "woman's dentalia" are quite common, the longer, quaintly ornamented shells are becoming scarcer and scarcer and it is only when some aged Indian, pressed by the high cost of living and importuned by his younger and more modern relatives, reluctantly parts with his symbol of wealth, that the old time money comes to light.

In primitive times, the dentalium shells used as money were from one and seven-eighths to two and one-half inches in length. The longest shells were valued at $5 each, the shortest between twenty-five and fifty cents. The shells were strung on leather or sinew cords, eleven to fifteen shells being the general length of the strings. The eleven shell string was the most valuable and allowing for fluctuation and method of measurements was roughly valued at $50.

In measuring an individual shell, the units of measure were the fingers. The longest shells were placed on the little finger and a shell to be of the utmost value should reach from the farther crease of the little finger to the fold in the palm below. Other sizes were matched against the middle finger. In some cases men had their forearms tattooed with a series of marks whereby whole strings could be measured.

Currency of this sort was in demand and the owners treasured it above all else. The majority of such odd "coins" were often profusely decorated with incised lines or wrapped with thin spirals of snake skin. Occasionally woodpecker scalps would be tied in small tufts to the precious things. In order to keep

(*Just turn the page*)

GENERAL SCIENCE

Soap "Tails" Make Washing Possible

Following are additional reports of the meeting of the National Academy of Sciences at Urbana, Ill., by Edwin E. Slosson.

The chemistry of soap-suds was elucidated by Prof. W. D. Harkins of the University of Chicago. In the cleansing process the minute particles of soap capture and carry away drops of grease by surrounding them. The droplet of oil is too small to be seen, being only about one ten-thousandth of an inch in diameter, yet it requires twenty million molecules of soap to surround it with a film one molecule thick.

The soap molecule is fitted to act as the connecting link between oil and water for it consists of a long thin chain of carbon atoms, with one end of an oily mixture and the other more like water in composition. All the molecules of the soap line up in the same position around the oil drop with oil-like tails turned in towards the oil and with water-like heads sticking out towards the surrounding water. The oily ends are charged with negative electricity and so the oil drops are kept apart by the mutual repulsion of their negative charges. Thus particles of dirt or grease can be held in suspension in water in the form of an emulsion although they are insoluble in water.

Leprosy Being Conquered

Leprosy, the most horror-inspiring of human diseases ever since Bible times, is being knocked out by a combination of botanical and chemical research. Speaking before the Academy, Dr. Roger Adams told how chaulmoogra oil, brought to the western world by botanical explorers in the Orient, is being improved on by the synthetic chemist. The oil itself is not the thing that is deadly to the leprosy germ, it was found, but rather two natural acids which developed from it. Chemical examination of these acids showed that each was built of a five-cornered ring of carbon and hydrogen atoms, with a chain of other atoms sticking out at one side like a tail. By piling extra atoms on this tail at a certain point, brand-new kinds of acid, that had never existed anywhere before, could be created. And it was found that these new acids were far more effective as leprosy germ killers than the natural acids—some of them as much as fifty or a hundred times as strong as the natural product.

Fight Against Corn Blight

A nation-wide campaign against blight or scab affecting corn, winter wheat and other crops, to be carried on by the cooperation of the agricultural experiment stations of Wisconsin and Illinois and the U. S. Department of Agriculture, was announced by Dr. L. R. Jones of the University of Wisconsin.

The cabbage wilt that threatened a few years ago to wipe out the cabbage crop from Kansas to the Atlantic coast has been kept in check by cultivating resistant varieties. Dr. J. C. Walker, one of Prof. Jones' students, found that certain plants remained unharmed in fields devastated by the disease. By breeding from such immune individuals it has been possible to develop in all the principal types of cabbage forms capable of withstanding this malignant fungus.

The wilt disease of the China aster was next attacked by the same method of selection and controlled breeding, and now this undertaking seems to be on the eve of success. Asters resisting their wilt disease have been developed and seeds from this strain will soon be ready for sale.

In studies on resistant varieties of tobacco it was learned how the roots keep out the invading fungus. These malignant parasitic threads invade the tissues through minute natural wounds, in ordinary non-resistant varieties. Resistant varieties have the power of forming a layer of cork across such wounds so rapidly that entrance is impossible; or if the fungus has been quick enough to get a small start, a second-line defense of corky material is thrown across its path within the tissues, and thus effectually block it off.

"Presbyota"

A new name for an old ailment was sprung by Dr. J. McKeen Cattell, editor of the periodical *Science* and formerly professor of psychology at Columbia University. It is "presbyota," which is Greek for "old ears," and may hereafter be used by elderly persons in place of saying that they are "a bit hard of hearing." It corresponds to "presbyopia," which applies to the falling off in sharpness of sight characteristic of advancing years.

Dr. Cattell believes that such deficiency of hearing may be regarded

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Chemical "Tails" on Soap

(*Continued from page* 281)

as normal after middle life and he ascribes it to a gradual loss of elasticity in the receiving apparatus of the ear, which does not react as readily as formerly to the rapid vibrations of the voice. The ear is slower to respond to the shorter waves and the motion subsides more gradually. Consequently words or notes of music following in quick succession are run together and indistinguishable.

Persons with "presbyota" find it impossible to hear sounds of high frequency such as a shrill whistle or the chirp of a cricket or katydid. The uppermost notes of a piano carry nothing to their ears but the click of the keys. Since we distinguish voices and appreciate music mainly by the overtones of high frequency, elderly people have difficulty in listening to a lecture or theater performance.

As Dr. Cattell said: "Sounds separated by one five-hundredth of a second can be discriminated, but with speech sounds given at longer intervals are fused. We can speak about as rapidly as we can hear—some twenty changes a second. In order to be heard by one of deficient hearing, or by an audience, it is necessary to speak not more loudly, but more distinctly and more slowly. If we try to make ourselves heard by shouting, we only distort and blur the tones, like an overloaded radio loudspeaker."

Science News-Letter, October 29, 1927

Samples of air in different parts of Paris are being collected and analyzed in order to determine the degree of offensive odors and the extent of uncleanliness.

News-Letter Features

Born over five years ago of the demand and interest of those individuals who had caught a glimpse of *Science Service's* news reports to newspapers, the SCIENCE NEWS-LETTER has since proved interesting to laymen, scientists, students, teachers and children.

Into the pages of the NEWS-LETTER are fed the cream of *Science Service's* output directed at the newspapers of the world. To this is added material especially prepared.

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Regular articles tell of the happenings in the *skies* and in the great *outdoors.*

Photographs aid in the telling of the week's science.

Science News-Letter, October 29, 1927

Eighty-nine per cent of the gasoline tax receipts are used for rural roads and highways.

It has been estimated that eggs and poultry produced in the United States equal in value all the gold and silver mined throughout the world.

A German inventor is said to have patented a slow motion picture apparatus which makes it possible to take as many as 48,000 pictures a second.

Indian Tooth Shell Money

(*Continued from page* 281)

the "otlwetsik" or "human beings their dentalium" as it was called by the Yuroks, safe from harm, the Californian financiers carried their wealth in purses made of elk horn, hollowed out and decorated with incised geometric designs.

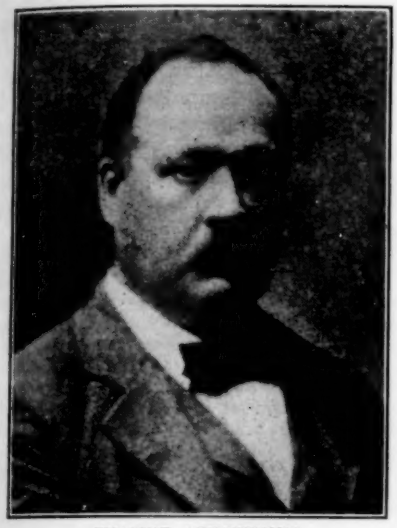
Strangely enough, the tribes that prized the shell currency the most highly were not the ones who took it from the ocean bed. The dentalia in olden times were fished from sand bars off the mouths of northern rivers by Indians inhabiting Vancouver Island, the northern coast of Oregon and British Columbia.

The shells were traded southward and after passing through several hands finally arrived in the California country where they were eagerly received.

With such wealth the tribal magnates bought houses and canoes, wives and clothing, furs, obsidian blades, woodpecker scalps, tobacco, etc. The obsidian blades, huge things often two and a half feet long and five inches and more in width, of both black and red obsidian, and the brilliant red top knots of the common woodpecker were also deemed units of wealth. Even today these objects are held above all other items of native manufacture or use. The albino or white deer skin is likewise considered a rare treasure and when a man can display such a skin in the "White Deerskin" dance along with one or more obsidian blades and a headband of redheaded woodpecker scalps, he is indeed a plutocrat.

Science News-Letter, October 29, 1927

Classics of Science: Electrolytic Dissociation



SVANTE ARRHENIUS

Arrhenius' theory of electrolytic dissociation solved several baffling puzzles of electro-chemistry and provided a mechanism for explaining the curious fact that dissolved salts obey the long-known gas laws. The following extracts from the fifth and sixth Stillman lectures for 1912 give Arrhenius' own outline of the history of the science he did so much to develop.

THEORIES OF SOLUTIONS, by Svante Arrehenius, Yale University Press, 1912.

Theories of Physical Chemistry

It is well known to all of us that the present great advance in physical chemistry is due chiefly to the introduction of two theories, the one expressing the far-reaching analogy existing between the gaseous and the dissolved states of matter, with which follows the thermodynamic treatment of chemical equilibria in solutions, and the other indicating that salts (acids and bases are regarded as hydrogen salts and as hydrates respectively) are in solution partially dissociated into their ions. As a rule it is said that this new development came abruptly and many people believe that for this reason the merit of these theories is greatly increased. I am of quite an opposite opinion. The ideas mentioned may be found in a less fully developed state in older speculations regarding the chemical behavior of solutions and we ought to lay great stress upon this fact, for it is the most convincing proof of their soundness that they should have developed quite continuously and organically from all the results of chemical experience. Of course when they at first took form, the ideas were deduced from a rather small number of observations, so that their usefulness was not very evident and on the other hand, the conservative majority of scientists were opposed to the introduction of new notions which seemingly complicated their conception of Nature. The new points of view therefore lived a latent life, being again and again indicated, until there had been collected together a quantity of experimental material sufficient to demand the explanation which they were capable of giving. At such a stage in the evolution of new ideas, a rapid propagation of them takes place under sharp opposition from the teachers of the old conceptions and in the end they receive an overwhelming support simply because of the great importance of the phenomena which they alone are able to explain.

This normal course of evolution may easily be traced for the modern theory of physical chemistry. The chief progress in it is due to the discovery that the molecules of dissolved substances behave in a manner very similar to that of gases. The laws governing the properties of gases are well known and simple; by their application to the much greater and more important group of solutions we have won an extremely valuable knowledge of the nature of solutions which play by far the foremost role in chemistry. At the same time the far-reaching use of the laws of thermodynamic in this new chapter gave it its strength and high value.

Newton's Observations

It is here in place to recall the interesting statement of Newton that the dissolved molecules in a solution tend to get away from each other so that they finally become distributed uniformly in the solvent.

In reality this idea gives a neat explanation of the phenomena of diffusion, which are so closely related to the force of osmotic pressure. Newton regarded this tendency of dissolved molecules as due to reciprocal repulsion of the dissolved molecules, just as the diffusion of gas-molecules may be regarded as effected by the mutual repulsion of those molecules. One might well say that the modern views regarding the analogy between gaseous and dissolved substances might well have been developed from this conception of Newton. But the time was not then ripe. The experimental knowledge of chemical phenomena was too scarce for the formulating of laws regarding them. In the year 1839 Gay-Lussac expressed opinions which possess a startling suggestion of modernity. "As the effects of affinity do not change with temperature (he would better have said change but slowly with temperature), whereas dissolution (solubility) is in a high degree dependent upon it, it is very difficult to avoid the assumption that in dissolution as well as in evaporation the product is essentially limited, at a given temperature, by the number of molecules which are able to exist in a certain volume of the solvent. They are separated from this, just as gaseous molecules are precipitated by a lowering of temperature. . . . Dissolution is therefore in a high degree connected with evaporation, namely in this respect that both of them depend on the temperature and are subject to its variations. Hence they ought to show if not a complete identity in their effects at least a great analogy." The objection that in some cases, *e. g.*, with sulphate or selenate of sodium, the solubility-curve shows a break and sometimes a fall with increasing temperature, whereas this is not the case with the vapor-tension, is refuted by means of the assertion that at the temperature where the break occurs, the substance undergoing solution is subject to a transformation.

There is, however, a difference between a gas and a dissolved substance. "The molecules of the gas do not need a solvent to hold them in suspension in a certain volume; their mutual repulsion is enough for that purpose. On the other hand, when a solid or liquid substance is dissolved, its molecules would not remain in the limited volume if they were not united by their affinity to the molecules of the solvent."

Osmotic Pressure in Plant Cells

Van't Hoff's fundamental discovery in 1885 was directly due to the investigations of De Vries and Pfeffer on the osmotic pressure of certain plant cells. They investigated a property well-known to cell-physiologists, namely that if cells are placed in aqueous solutions they take water from the solution, if this is weak, and give up water to it, if it is strong. With a certain concentration of the solution equilibrium is obtained. De

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Classics of Science

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Vries found that solutions of glycerol or of cane sugar, which contain the same number of molecules per liter, are in equilibrium with the same cells. Also equimolecular solutions of KCl, NaCl, KNO_3 and $NaNO_3$ are found to be in equilibrium with the same cells. But these salt solutions are only 0.6 times as concentrated as the corresponding solutions of glycerol or cane sugar which are in equilibrium with the same cells.

Now Moritz Traube in 1867 had given a method of preparing artificial cells, which possess the properties of attracting water from or giving it up to surrounding aqueous solutions according to their concentrations, just like natural cells. In 1877 Pfeffer used Traube's cells for measuring the force with which distilled water was attracted into such a cell filled with a solution of, *e. g.*, 1 per cent. cane sugar. If the solution in the cell is subjected to a certain pressure the water is driven out from the sugar solution: the sugar itself does not pass through the cell walls, which latter consisted of a thin membrane of ferro-cyanide of copper, precipitated in the porous walls of an earthenware vessel. At a certain pressure, which was found to be 505 millimeters of mercury at 6.8° C., equilibrium was reached so that no water went into the cell from the surrounding distilled water and no water was pressed out from the solution of cane sugar through the cell walls. This pressure, the so-called osmotic pressure of a solution of 1 per cent. cane-sugar, increases with temperature. It is nearly proportional to the concentration of the sugar-solution when this is changed.

Sugar in Solution Obeys Gas Laws

These results of Pfeffer's measurements were communicated to van't Hoff by his friend De Vries, who asked for a theoretical explanation. Van't Hoff made the following simple calculation: A gas containing one gram molecule in 22,400 c.c. at 0° C. possesses a pressure of just 1 atmosphere or 60 millimeters of mercury. At 6.8° C. the pressure is a little higher, namely, 779 millimeters, according to the law of Gay-Lussac. If this gas was expanded until it contained one molecule in 34,200 c.c.,which is the concentration of a 1 per cent. solution of cane sugar—the molecular weight of cane sugar being 342—its pressure at 6.8° C. would according to Boyle's law be 508 millimeters. This figure agrees within 1 per cent. and within the errors of observation in Pfeffer's experiments with that, 505 mm., found for the osmotic pressure of an equimolecular solution of cane sugar. In other words the osmotic pressure increases proportionally to the concentration (just as the gas pressure does according to Boyle's law) and within the errors of experiment as van't Hoff deduced from Pfeffer's figures, also to the absolute temperature (as in Gay-Lussac's law for gases), there exists a perfect analogy between the osmotic pressure of a solution (of cane sugar) and the pressure of a gas containing the same number of molecules in the same volume.

As soon as this fundamental fact was stated, van't Hoff applied all the laws which had been deduced from thermodynamics for the pressure of gases and for saturated vapors, which correspond to saturated solutions, to the osmotic pressures of dissolved substances. . . .

The whole investigation of van't Hoff (1885) was a triumphant march through the different domains of physical chemistry; only one difficulty, but a rather severe one, was found. The great majority of substances examined did not follow the law of Avogadro, as cane sugar did. This was already manifest from De Vries' investigations, according to which one molecule of sodium chloride exerts the same osmotic pressure as about 1.7 molecules of cane-sugar dissolved in the same quantity of water. To account for this difference, van't Hoff introduced a coefficient i (the isotonic coefficient) which was determined experimentally. . . .

This was a great inconvenience, for it really spoilt the analogy between the dilute and the gaseous states of matter, but it was very soon eliminated by the theory of electrolytic dissociation. . . .

Conductivity and Dilution

In 1883 I investigated the conductivity of electrolytes as depending on their concentration and temperature and came to the conclusion (published 1884) that their solutions contain two different kinds of molecules, of which the one is a non-conductor, the other conducting electricity in consequence of properties attributed to it by the hypothesis of Gay-Lussac, Williamson and Clausius. These latter were simply called active molecules. The number of active molecules increases with dilution at the expense of the inactive ones and tends to a limit, which is probably first reached when all inactive molecules have been transformed into active ones. At very high dilutions the additive property of the conductivity postulated by Kohlrausch is not only true within certain groups of electrolytes of similar composition but for all electrolytes of whatsoever composition. An acid is the stronger the greater its conductivity. At infinite dilution all acids have the same strength. These assertions were demonstrated to be in accord with the thermochemical measurements of Berthelot and Thomsen. Similar rules are valid for bases. Chemical activity therefore coincides with electrical activity.

Svante August Arrhenius was born February 19, 1859, at Wijk, near Upsala, Sweden, and died October 2, 1927 at Stockholm. He is the author of the theory of electrolytic dissociation of salts in solution, which was first announced in 1883 when he was 24 years old. It is one of the most important theories of physical chemistry, and for it he received the Nobel prize for Chemistry in 1903.

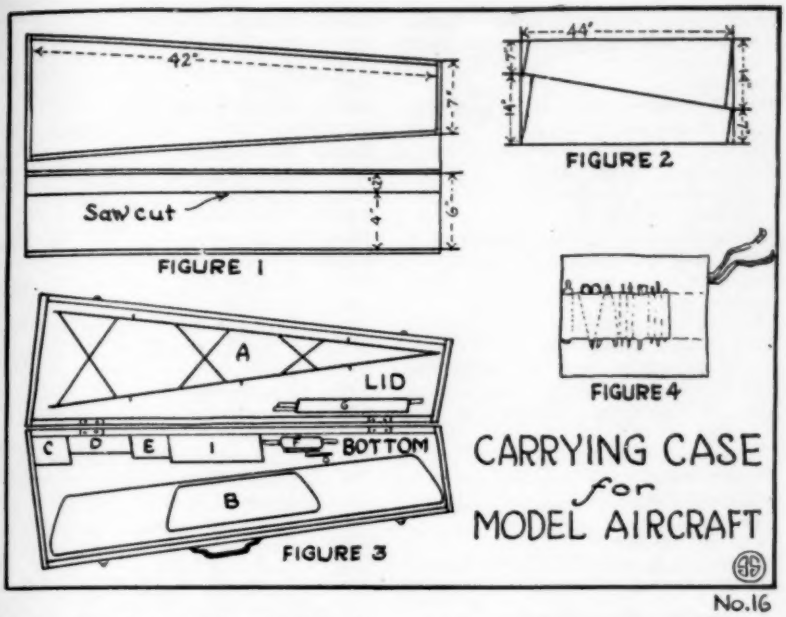
Science News-Letter, October 29, 1927

MEMORANDUM

This blank space serves a dual purpose. It allows you to clip out the article on the reverse of this page without destroying any other article. It can also be used for notes and the recording of your own observations.

AVIATION

Building and Flying Model Airplanes



This is the eleventh of a series of articles by Paul Edward Garber, telling how to make model airplanes. Mr. Garber is in charge of aeronautics at the Smithsonian Institution.

An Airplane Carrying Case

A model airplane when completed is a constant source of happiness to its maker, either when in the air demonstrating its abilities, or when displayed at home, to show one's handiwork. During its construction, and when carrying it to the flying field, however, it is best to keep it protected and enclosed. This is best done through use of a model box. Practically all model flyers have one and as they are easily made, you should follow their example. Procure the following materials:

1 board of white pine, 9 ft. x 6 in. x ½ in.
1 piece compo board, or other wallboard, 44 in. x 21 in.
2 butt hinges, 1½ in. x ½ in.
2 fasteners, such as are used on handbags.
1 drawer handle, with open loop.
2 doz. ¼ in. screw eyes.
6 yards ½ in. tape.
Screws, nails, paint.

After squaring the ends of the board, cut from it two pieces forty-two inches long, one piece seven inches long, and one piece fourteen inches long. Plane the ends of the two forty-two-inch pieces to a slight angle so they will make a snug fit when the frame is nailed together by fastening the two pieces at the ends, as shown in the drawing. Next cut the wallboarding in the manner illustrated in the drawing, and nail these as sides onto the frame. Use glue in all the joints of the frame, and for nailing on the sides use flat head nails about No. 14, 1 inch long. Finishing nails should be used for nailing up the frame. In order to form the lid and lower section, cut the box in half, along a line drawn about two inches from a side. Plane and true up the rough edges left by the saw, and while you hold the two sides together, mark the place for the hinges and fasteners. Slightly indent the hinges into the back edges, in order that the completed box may fit snugly together. If handbag fasteners are difficult to get, ordinary window catches may be substituted, or even common screen door hooks will do as a last resource. The model box should next be painted or covered with imitation leather on the outside, and shellaced or painted inside. Its handiness may be greatly increased if spaces are provided for various spare parts, and tools. The drawing suggests an interior arrangement. A is the model fuselage held in the lid, B is the wings, C a can containing the rubber strands used for power; incidentally the rubbers should be well powdered with soapstone or talcum powder to preserve them. D is a box for small fittings, adhesive, rubber bands, etc., E a roll of tools for making repairs on the field, F is a winder held in place by a cleat or strap, G is a bundle of sticks and fabric for repairs and H shows a spool of wire and thread, fastened together on a short stick, and held in the corner by an elastic band. When the model box has been loaded to the condition that it will be used for traveling, find the balancing point and attach the handle to the top. Many makers delight in decorating their model boxes neatly with their Model insignia, or their own monogram. Nickel or brass corners, such as valise makers use, make the box more durable and attractive.

Figure 4 shows a tool roll which may be easily made from a piece of cloth. A center strip is stitched to leave pockets for tools and a flap is left at each side and the end for covering the tools, with tapes for tieing it up.

When the model maker decides to attend distant model contests a box such as this is a necessity, but regardless of such use, it is always a convenience.

Science News-Letter, October 29, 1927

GENERAL SCIENCE

Why Not Look?

In the year of our Lord 1432, there arose a grievous quarrel among the brethren over the number of teeth in the mouth of a horse. For thirteen days the disputation raged without ceasing. All the ancient books and chronicles were fetched out, and wonderful and ponderous erudition, such as was never before heard of in this region, was made manifest. At the beginning of the fourteenth day, a youthful friar of goodly bearing asked his learned superiors for permission to add a word, and straightway, to the wonderment of the disputants whose deep wisdom he sore vexed, he beseeched them to unband in a manner coarse and unheard-of and to look in the open mouth of a horse and find answer to their questionings. At this, their dignity being grievously hurt, they waxed exceedingly wroth; and, joining in a mighty uproar, they flew upon him and smote him hip and thigh, and cast him out forthwith. For, said they, surely Satan hath tempted this bold neophyte to declare unholy and unheard-of ways of finding truth contrary to all the teachings of the fathers. After many days more of grievous strife the dove of peace sat on the assembly, and they as one man, declaring the problem to be an everlasting mystery because of a grievous dearth of historical and theological evidence thereof, so ordered the same writ down. —Quoted in *Science Progress* as accredited to Francis Bacon.

Science News-Letter, October 29, 1927

Aviators are investigating flying conditions through Africa to test the practicability of an air route from Capetown to Cairo.

How to Use Key-Word Feature of News-Letter

In order to aid in catching the items that concern you and to facilitate clipping and filing, a key word in small capitals has been printed on the right of the line above each article. The key words used fit into any system of classification, whether it be a straight alphabetical file, a system of your own devising, the Library of Congress classification or the Dewey system.

Note that you can clip out any article without fear of damaging another article in which you might be interested, since editorial matter printed on the right-hand pages is backed by advertising, standing matter or a continuation of the article on the other side.

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The classification of the Library of Congress has come into common use in the libraries of the country owing to the publication by the Government of the card index of all new books. We print below a list of the subject titles which are most used in the SCIENCE NEWS-LETTER. The full scheme of classification is contained in "Outline Scheme of Classes," issued by the Library of Congress.

A General Works. Polygraphy.
B Philosophy.
BF Psychology.
G Geography, voyages, travel.
GA Mathematical and astronomical geography.
GB Physical geography.
GC Oceanology and oceanography.
GF Anthropogeography.
GN Anthropology. Somatology. Ethnology. Ethnography. Prehistoric archæology.
GR Folklore.
GT Manners and customs.
GV Sports and amusements. Games.
HC Economic history and conditions. National production.
HD Economic history. Agriculture and Industries.
HE Transportation and communication.
HF Commerce.
HM Sociology. General.
HQ Family. Marriage. Woman.
HV Social pathology.
L Education.
M Music.
N Fine arts.
P Philology and linguistics.
Q Science. General.
QA Mathematics.
QB Astronomy.
QC Physics.
QD Chemistry.
QE Geology.
QH Natural history.
QK Botany.
QL Zoology.
QM Human anatomy.
QP Physiology.
QR Bacteriology.
R Medicine. General.
S Agriculture. General.
SB Field crops. Horticulture. Landscape gardening. Pests and plant diseases.
SD Forestry.
SF Animal culture. Veterinary medicine.
SH Fish culture and fisheries.
SK Hunting. Game protection.
T Technology. General.
TA Engineering. General.
TC Hydraulic engineering.
TD Sanitary and municipal engineering.
TE Roads and pavements.
TF Railroads.
TG Bridges and roofs.
TH Building construction.
TJ Mechanical engineering.
TK Electrical engineering and industries.
TL Motor vehicles. Cycles. Aeronautics.
TN Mineral industries. Mining and Metallurgy.
TP Chemical technology.
TR Photography.
TS Manufactures.
TT Trades.
TX Domestic science.
U Military science. General.
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The main divisions of the Dewey Decimal Classification, used in many libraries and by many individuals, is given below for the convenience of those who wish to use this system:

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010 Bibliography
020 Library economy
030 General cyclopedias
040 General collected essays
050 General periodicals
060 General societies
070 Newspapers
080 Special libraries. Polygraphy
090 Book rarities
100 PHILOSOPHY—
110 Metaphysics
120 Special metaphysical topics
130 Mind and body
140 Philosophical systems
150 Mental faculties. Psychology
160 Logic
170 Ethics
180 Ancient philosophers
190 Modern philosopers
200 RELIGION—
210 Natural theology
220 Bible
230 Doctrinal. Dogmatics. Theology
240 Devotional. Practical
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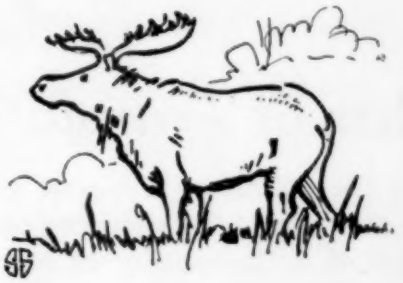
NATURE RAMBLINGS

By FRANK THONE



Moose

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BF Psychology.
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GA Mathematical and astronomical geography.
GB Physical geography.
GC Oceanology and oceanography.
GF Anthropogeography.
GN Anthropology. Somatology. Ethnology. Ethnography. Prehistoric archæology.
GR Folklore.
GT Manners and customs.
GV Sports and amusements. Games.
HC Economic history and conditions. National production.
HD Economic history. Agriculture and Industries.
HE Transportation and communication.
HF Commerce.
HM Sociology. General.
HQ Family. Marriage. Woman.
HV Social pathology.
L Education.
M Music.
N Fine arts.
P Philology and linguistics.
Q Science. General.
QA Mathematics.
QB Astronomy.
QC Physics.
QD Chemistry.
QE Geology.
QH Natural history.
QK Botany.
QL Zoology.
QM Human anatomy.
QP Physiology.
QR Bacteriology.
R Medicine. General.
S Agriculture. General.
SB Field crops. Horticulture. Landscape gardening. Pests and plant diseases.
SD Forestry.
SF Animal culture. Veterinary medicine.
SH Fish culture and fisheries.
SK Hunting. Game protection.
T Technology. General.
TA Engineering. General.
TC Hydraulic engineering.
TD Sanitary and municipal engineering.
TE Roads and pavements.
TF Railroads.
TG Bridges and roofs.
TH Building construction.
TJ Mechanical engineering.
TK Electrical engineering and industries.
TL Motor vehicles. Cycles. Aeronautics.
TN Mineral industries. Mining and Metallurgy.
TP Chemical technology.
TR Photography.
TS Manufactures.
TT Trades.
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020 Library economy
030 General cyclopedias
040 General collected essays
050 General periodicals
060 General societies
070 Newspapers
080 Special libraries. Polygraphy
090 Book rarities
100 PHILOSOPHY—
110 Metaphysics
120 Special metaphysical topics
130 Mind and body
140 Philosophical systems
150 Mental faculties. Psychology
160 Logic
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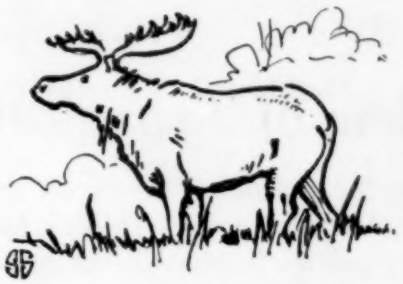

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